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*June 1999*



***Mathematics 33***  
***Grade 12 Diploma Examination***

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June 1999

# Mathematics 33

## Grade 12 Diploma Examination

### Description

Time: 2.5 h. This examination was developed to be completed in 2.5 h; however, you may take an additional 0.5 h to complete the examination.

This is a **closed-book** examination consisting of

- 37 multiple-choice and 12 numerical-response questions, of equal value, worth 70% of the examination
- 4 written-response questions worth 30% of the examination

This examination contains sets of related questions.

A set of questions may contain multiple-choice and/or numerical-response and/or written-response questions.

A mathematics data booklet is provided for your reference.

**Note:** *The perforated pages at the back of this booklet may be torn out and used for your rough work. No marks will be given for work done on the tear-out pages.*

### Instructions

- You are expected to provide your own scientific calculator.
- Use only an HB pencil for the machine-scored answer sheet.
- Fill in the information required on the answer sheet and the examination booklet as directed by the presiding examiner.
- Read each question carefully.
- If you wish to change an answer, erase **all** traces of your first answer.
- Do not fold the answer sheet.
- The presiding examiner will collect your answer sheet and examination booklet and send them to Alberta Education.
- Now turn this page and read the detailed instructions for answering machine-scored and written-response questions.

### *Multiple Choice*

- Decide which of the choices **best** completes the statement or answers the question.
- Locate that question number on the separate answer sheet provided and fill in the circle that corresponds to your choice.

### Example

This examination is for the subject of

- A.** biology  
**B.** physics  
**C.** chemistry  
**D.** mathematics

## Answer Sheet

Ⓐ Ⓑ Ⓒ Ⓓ

### Numerical Response

- Record your answer on the answer sheet provided by writing it in the boxes and then filling in the corresponding circles.
- If an answer is a value between 0 and 1 (e.g., 0.7), then be sure to record the 0 before the decimal place.
- **Enter the first digit of your answer in the left-hand box and leave any unused boxes blank.**

### Examples

### Calculation Questions and Solutions

The value of  $\tan 35^\circ$  to the nearest tenth is

(Record your answer in the numerical-response section on the answer sheet.)

Calculator value: 0.7002075

Value to be recorded: 0.7

**Record 0.7 on the  
answer sheet —**

The constant term in the quadratic function  $y = 2x^2 + 7x + 32$  is \_\_\_\_\_.

(Record your answer in the numerical-response section on the answer sheet.)

Value to be recorded: 32

Record 32 on the answer sheet

3	2		
---	---	--	--

•	•		
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

### Correct-Order Question and Solution

When the following subjects are arranged in alphabetical order, the order is \_\_\_\_\_.

- 1 biology
- 2 physics
- 3 chemistry
- 4 mathematics

(Record **all four digits** of your answer in the numerical-response section on the answer sheet.)

Value to be recorded: 1342

Record 1342 on the answer sheet

1	3	4	2
---	---	---	---

•	•		
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

### Written Response

- Write your answers in the examination booklet as neatly as possible.
- For full marks, your answers must address **all** aspects of the question.
- Descriptions and/or explanations of concepts must be correct and include pertinent ideas, diagrams, calculations, and formulas.
- Your answers must be presented in a well-organized manner using complete sentences and correct units.

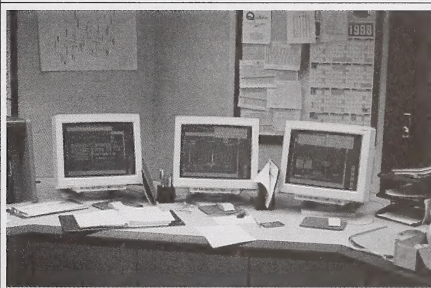
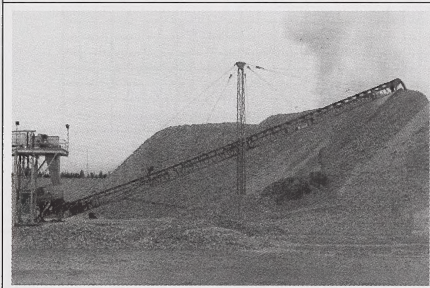




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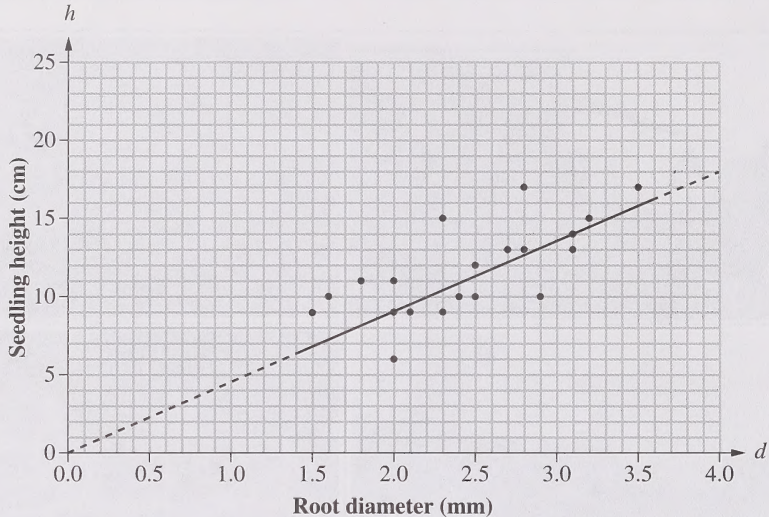
## ALBERTA INDUSTRY

Employees in the Alberta pulp and paper industry use mathematical skills to solve problems related to their companies' operations. Answer the following questions related to this industry.



Use the following information to answer the first two questions.

A pulp and paper company operates a tree nursery to provide seedlings for reforestation. To analyze the relationship between the height of tree seedlings and their root diameter, a biologist completed the scatter plot shown below. He included a line of best fit.



### Numerical Response

1. Based on the line of best fit, if the height of a seedling is 14 cm, then the predicted root diameter, to the nearest tenth of a millimetre, will be \_\_\_\_\_ mm.

(Record your answer in the numerical-response section on the answer sheet.)



Use the following additional information to answer the next question.

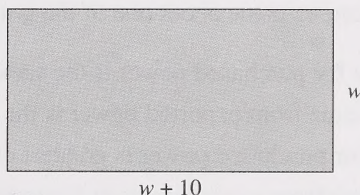
The biologist made the following inference based on the line of best fit: “As the root diameter increases, the seedling height   *i*   at a rate of about   *ii*   cm per 1.0 mm increase in root diameter.”

1. The row that completes the statement above is row

Row	<i>i</i>	<i>ii</i>
A.	decreases	5.5
B.	increases	5.5
C.	decreases	4.5
D.	increases	4.5

Use the following information to answer the next question.

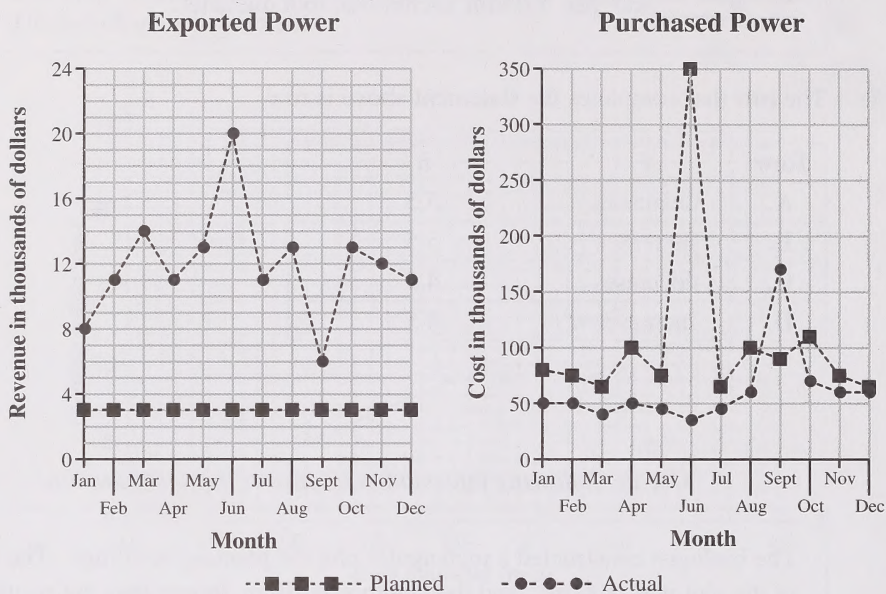
The biologist constructed a rectangular plot for planting seedlings. The area of the plot was  $100 \text{ m}^2$ , and the length was 10 m longer than the width, as shown below.



2. If the width of the plot, in metres, is represented by  $w$ , then an equation that could be used to determine  $w$  is
- A.  $2w^2 + 20w = 0$
- B.  $10w^2 - 100 = 0$
- C.  $w^2 + 10w - 100 = 0$
- D.  $w^2 + 10w + 100 = 0$

Use the following information to answer the next two questions.

An accountant for the pulp and paper company analyzed the two graphs shown below.



3. A statement that can be made about one of the graphs above is that the
  - A. planned cost for purchased power is the same each month
  - B. planned revenue from exported power is the same each month
  - C. actual cost for purchased power is greatest during the month of June
  - D. actual revenue from exported power is greatest during the month of September
  
4. The **difference** between the highest and lowest values of the graph displaying the actual revenue from exported power is
  - A. \$6 000
  - B. \$8 000
  - C. \$14 000
  - D. \$20 000



Use the following information to answer the next question.

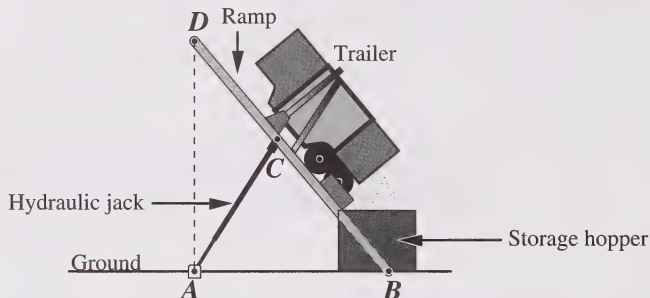
Management at the pulp and paper company wanted to double its raw material output. To accomplish this, the company borrowed \$80 million at a rate of 3% per annum compounded monthly, and made monthly payments of \$2 million to repay the loan. The first several entries are shown in the amortization spreadsheet below.

Monthly Payment Period	Amount Paid/ Month	Interest Paid/Period	Principal Paid/Month	Outstanding Balance
0				\$80 000 000
1	\$2 000 000	$\$80\,000\,000 \times \frac{1}{4}\% = \$200\,000$	\$1 800 000	\$78 200 000
2	\$2 000 000	$\$78\,200\,000 \times \frac{1}{4}\% = \$195\,500$	\$1 804 500	\$76 395 500
3	\$2 000 000	<i>i</i>		

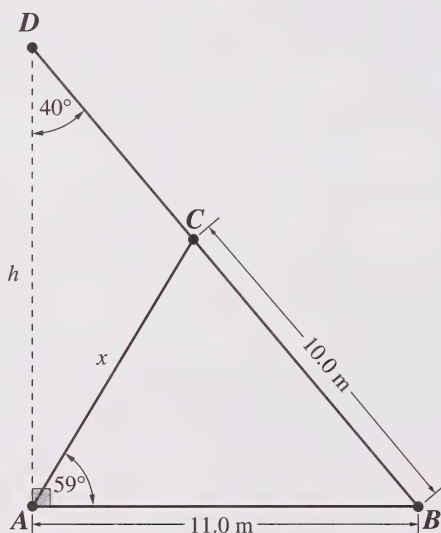
5. The amount of interest, *i*, that should be charged for the third payment period, to the nearest dollar, is
- A. \$191 000
  - B. \$190 989
  - C. \$190 500
  - D. \$185 989

Use the following information to answer the next question.

When a truck brings wood chips to the plant for processing, the trailer is backed onto a ramp. A hydraulic jack then lifts the ramp so that the wood chips are dumped from the trailer into a storage hopper, as shown below.



A simplified diagram of the hydraulic ramp with some dimensions is shown below.



**Written Response — 5 marks**

1. a. Calculate the missing measure of  $\angle DBA$  in  $\triangle DAB$  and **indicate** this measure on the diagram above.



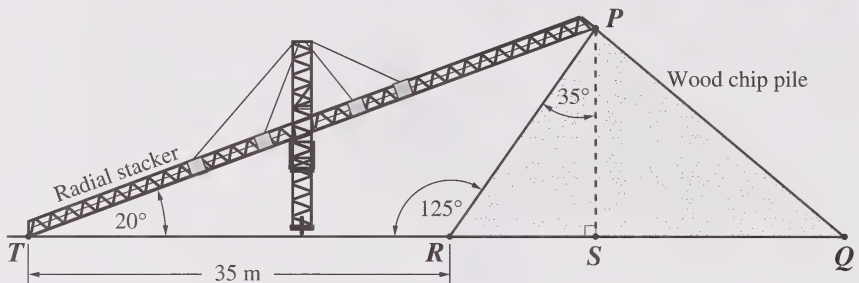
- b.** Determine the length of the hydraulic jack,  $x$ , to the nearest tenth of a metre. Support your answer mathematically.

- c.** • Determine the height of the ramp,  $h$ , to the nearest tenth of a metre. Support your answer mathematically.

- The company's safety regulations state that the maximum height that the end of the ramp (point  $D$ ) can safely reach is 15 m. Explain whether or not the height of the ramp,  $h$ , complies with the company's safety regulation.

Use the following information to answer the next question.

The wood chips from the storage hopper are moved up a radial stacker and are stored in a wood chip pile, as shown in the cross-section diagram below.



To calculate the maximum height of a wood chip pile under the conditions given in the diagram, an employee completes the following four steps.

- 1 State the maximum height of the wood chip pile.
- 2 Determine the measure of angle  $\angle TPR$ .
- 3 Calculate the length of  $\overline{RP}$ .
- 4 Calculate the length of  $\overline{PS}$ .

### Numerical Response

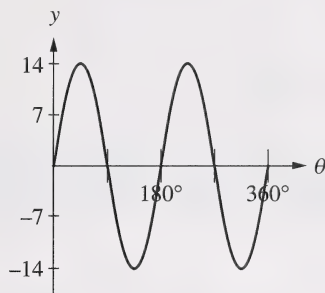
2. The order in which the above steps must be completed to determine the maximum height of the wood chip pile is \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_.

(Record **all four digits** of your answer in the numerical-response section on the answer sheet.)



*Use the following information to answer the next question.*

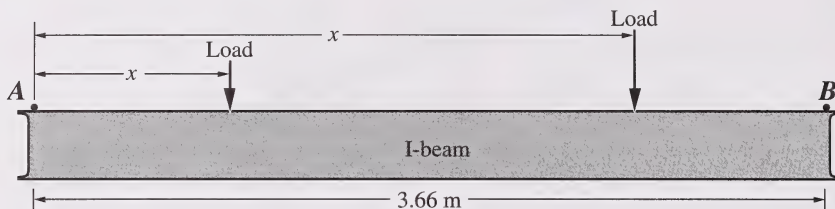
A technologist at the plant monitors the voltage output pattern of a generator, as illustrated below.



6. An equation that could be used to produce the graph above is
- A.  $y = \sin 2\theta$
  - B.  $y = \sin 14\theta$
  - C.  $y = 14 \sin \theta$
  - D.  $y = 14 \sin 2\theta$

Use the following information to answer the next question.

An engineer needed to determine how far toward the centre from either end of a steel I-beam a load can be placed safely. The engineer established the reference point at  $A$ , as shown in the diagram below.



To determine the two distances,  $x$ , in metres, from point  $A$ , the engineer used the quadratic equation  $2.46x^2 - 9.0x + 5.32 = 0$ , and began to solve for  $x$  by writing

$$x = \frac{-(-9.0) \pm \sqrt{(-9.0)^2 - 4(2.46)(5.32)}}{2(2.46)}$$

7. The values for  $x$  could be represented by

A.  $x = \frac{9.0 \pm \sqrt{28.6512}}{4.92}$

B.  $x = \frac{4.5 \pm \sqrt{28.6512}}{2.46}$

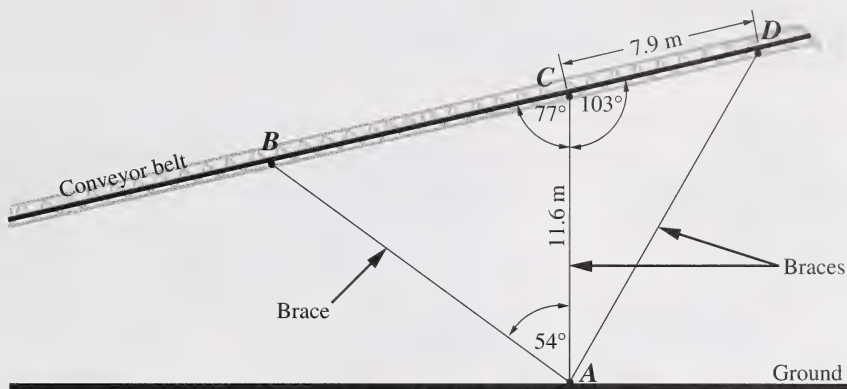
C.  $x = \frac{9.0 \pm \sqrt{133.3488}}{4.92}$

D.  $x = \frac{4.5 \pm \sqrt{133.3488}}{2.46}$



Use the following information to answer the next question.

The engineer also analyzed a cross-section diagram that represented a conveyor belt used to move pulp into the plant, as shown below.



Two braces,  $\overline{AB}$  and  $\overline{AD}$ , had to be replaced.

8. To determine the length of the first brace,  $\overline{AB}$ , the engineer could use the equation

A.  $\frac{\overline{AB}}{\sin 54^\circ} = \frac{11.6}{\sin 49^\circ}$

B.  $\frac{\overline{AB}}{\sin 77^\circ} = \frac{11.6}{\sin 49^\circ}$

C.  $\frac{\overline{AB}}{\sin 54^\circ} = \frac{11.6}{\sin 77^\circ}$

D.  $\frac{\overline{AB}}{\sin 77^\circ} = \frac{11.6}{\sin 54^\circ}$

Use the following information to answer the next question.

One of the processes monitored at the pulp and paper plant is the flow of wet pulp from a storage tank onto a conveyor table where it forms a pulp sheet. To maintain a uniform thickness of the pulp sheet, the speed ( $v$ ) of the conveyor table, in metres per minute, must correspond to the height ( $h$ ) of the pulp in the storage tank, in metres, according to the equation

$$h = \frac{v^2}{5\,889} + \frac{127}{5\,000}$$

### Numerical Response

3. If the speed,  $v$ , of the conveyor table must be 120 metres per minute, then the corresponding height of the pulp in the storage container,  $h$ , to the nearest hundredth of a metre, is \_\_\_\_\_ m.

(Record your answer in the numerical-response section on the answer sheet.)

\_\_\_\_\_

Use the following information to answer the next question.

A wrapping machine rotates bales of pulp from one conveyor belt to another. The angle of rotation is  $-90^\circ$  when displayed in standard position on a coordinate plane.

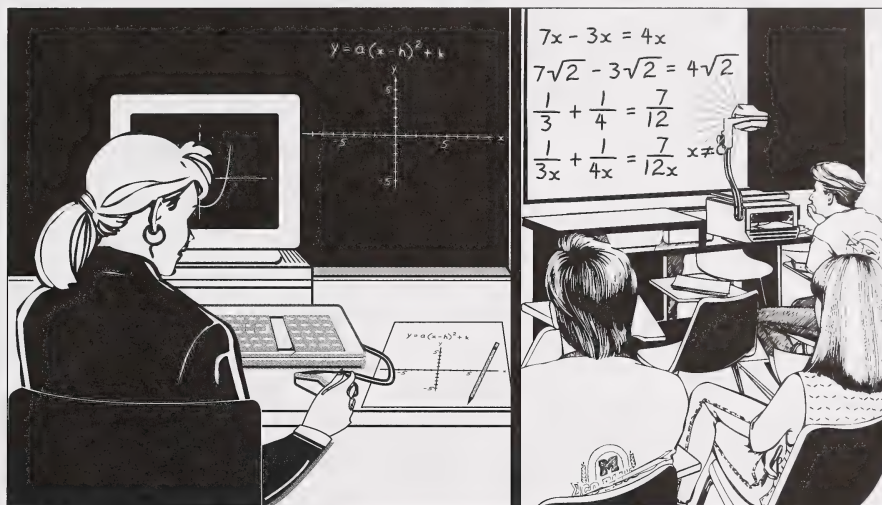
If the machine could rotate bales in the **opposite** direction to get to the same position, its movement would be represented in standard position on a coordinate plane by a \_\_\_\_\_ *i* \_\_\_\_\_ rotation angle of \_\_\_\_\_ *ii* \_\_\_\_\_.

9. The row that completes the statement above is row

Row	<i>i</i>	<i>ii</i>
A.	clockwise	$450^\circ$
B.	clockwise	$270^\circ$
C.	counterclockwise	$270^\circ$
D.	counterclockwise	$90^\circ$

## CONNECTIONS

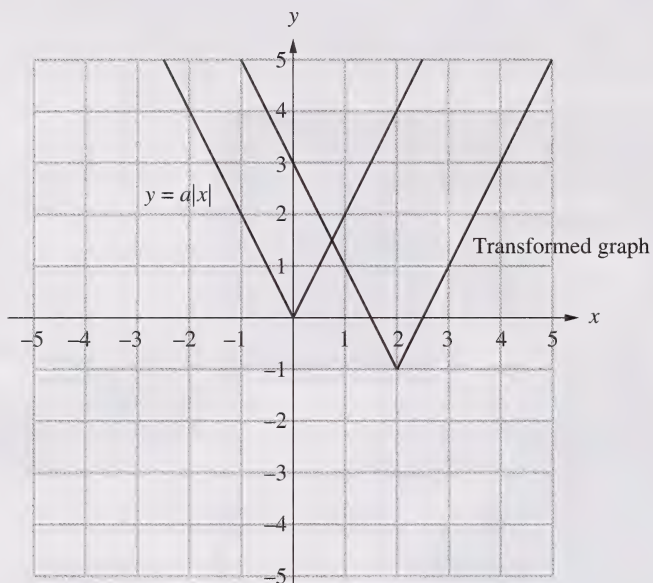
Students in Mathematics 33 analyze and explore relationships between equations and their graphical representations. They use skills acquired in working with fractions and polynomials to do operations on rational and radical expressions. The next set of questions is related to these connections.





Use the following information to answer the next question.

The graph of  $y = a|x|$ , where  $a > 0$ , and the graph of its transformation are shown below.



10. The equation of the transformed graph could be represented by

- A.  $y = a|x - 2| - 1$
- B.  $y = a|x + 2| - 1$
- C.  $y = a|x - 2| + 1$
- D.  $y = a|x + 2| + 1$

Use the following information to answer the next question.

To convert the quadratic function  $y = -2x^2 + 4x + 13$  into the completed square form  $y = a(x - h)^2 + k$ , a student performed the following steps.

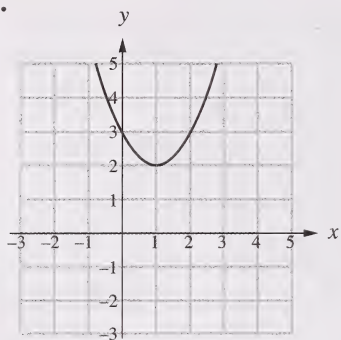
<b>Step I</b>	$y = -2(x^2 - 2x) + 13$
<b>Step II</b>	$y = -2(x^2 - 2x + 1) + 13 + 2$
<b>Step III</b>	$y = -2(x^2 - 2x + 1) + 15$
<b>Step IV</b>	$y = -2(x + 1)^2 + 15$

11. The student made an error in

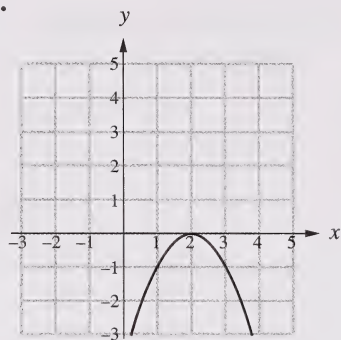
- A. step I
- B. step II
- C. step III
- D. step IV

12. A graph that represents a quadratic function that has a maximum  $y$  value of 2 is

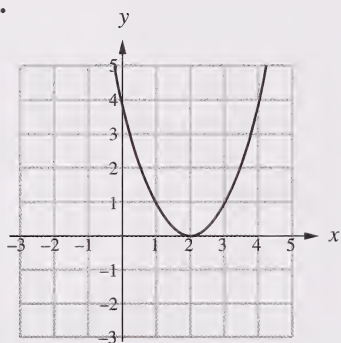
A.



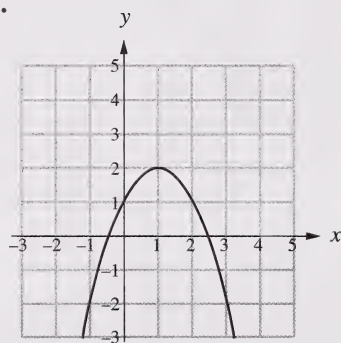
B.



C.



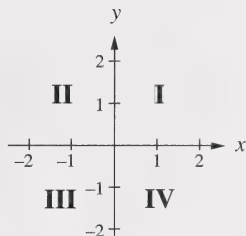
D.





Use the following information to answer the next question.

**Location of Quadrants in a Coordinate Plane**



13. An equation of a parabola with a vertex in quadrant III is

- A.  $y = 4\left(x + \frac{1}{2}\right)^2 - 15$
- B.  $y = 3\left(x + \frac{1}{2}\right)^2 + 15$
- C.  $y = 3\left(x - \frac{1}{2}\right)^2 - 15$
- D.  $y = 2\left(x - \frac{1}{2}\right)^2 + 15$
- 

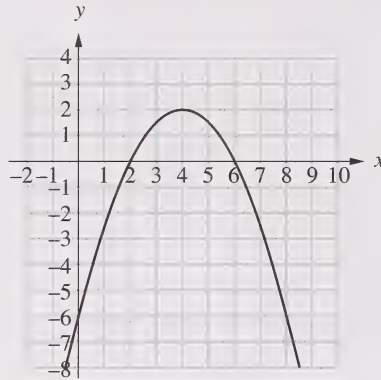
**Numerical Response**

4. The y-intercept of the graph of the function  $y = 0.5(x - 9.0)^2$ , to the nearest tenth, is \_\_\_\_\_.

(Record your answer in the numerical-response section on the answer sheet.)

Use the following information to answer the next question.

The graph of a quadratic function is shown below.



The roots of a quadratic equation may be found by examining the graph of its corresponding function.

14. The roots of the quadratic equation corresponding to the function of the graph above are
- A. -6, 2, and 6
  - B. -6 and 2
  - C. 2 and 4
  - D. 2 and 6
- 
15. The equation  $-3x + y = 15$  expressed in functional notation is
- A.  $f(x) = -3x + 15$
  - B.  $f(x) = -3x - 15$
  - C.  $f(x) = 3x + 15$
  - D.  $f(x) = 3x - 15$

16. The inverse of the function  $y = 3x - 6$  is

A.  $y = \frac{1}{3}x + 2$

B.  $y = \frac{1}{3}x + 6$

C.  $y = 3x + 2$

D.  $y = 3x + 6$

17. The expression  $\frac{x^2 + 5x}{4x^2 + 16x - 20}$ , where  $x \neq 1$  or  $-5$ , is equivalent to

A.  $\frac{1}{16}$

B.  $-\frac{2}{11}$

C.  $\frac{x}{x-4}$

D.  $\frac{x}{4(x-1)}$

18. A simplified form of  $\frac{3x^2 - 6x}{x^2 - x - 12} \div \frac{6x + 24}{x^2 + 7x + 12}$ , where  $x \neq -4$ ,  $-3$ , or  $4$ , is

A.  $\frac{3(x-2)}{-4}$

B.  $\frac{x(x-2)}{2(x-4)}$

C.  $\frac{18x(x-2)}{(x-4)(x+3)}$

D.  $\frac{3x(x-2)(x+3)}{(x-3)(x+4)}$



Use the following information to answer the next question.

To simplify the rational expression  $\frac{x}{x-1} - \frac{2}{x+2}$ , where  $x \neq -2$  or  $1$ , a student performed the following steps.

$$\text{Step I} \quad \frac{x(x+2)}{(x-1)(x+2)} - \frac{2(x-1)}{(x-1)(x+2)}$$

$$\text{Step II} \quad \frac{x^2 + 2x}{(x-1)(x+2)} - \frac{2x-2}{(x-1)(x+2)}$$

$$\text{Step III} \quad \frac{x^2 + 2x - 2x - 2}{(x-1)(x+2)}$$

$$\text{Step IV} \quad \frac{x^2 - 2}{(x-1)(x+2)}$$

19. When the student checked his work, he should have found an error in

- A. step I
- B. step II
- C. step III
- D. step IV

20. When written as an entire radical, the expression  $7b\sqrt{3}$ , where  $b > 0$ , is equivalent to

- A.  $\sqrt{441b^2}$
- B.  $\sqrt{147b^2}$
- C.  $\sqrt{63b}$
- D.  $\sqrt{21b}$

**Numerical Response**

5. If  $4\sqrt{27} + c\sqrt{3}$  is equivalent to  $242\sqrt{3}$ , where  $c > 0$ , then the value of  $c$  is \_\_\_\_\_.

(Record your answer in the numerical-response section on the answer sheet.)

21. When the expression  $2(\sqrt{12} + 3\sqrt{3}) - 5\sqrt{3}$  is written in the simplified form  $a\sqrt{b}$ , where  $a$  and  $b$  are whole numbers greater than 1, the value of  $a$  is

- A. 2
- B. 3
- C. 5
- D. 10

22. If a student rationalized the denominator of the radical expression  $\frac{5\sqrt{3}}{2\sqrt{7}}$  by writing  $\frac{5\sqrt{3}}{2\sqrt{7}} \times \frac{\sqrt{a}}{\sqrt{a}}$ , then the value of  $a$  could be

- A. 3
- B. 7
- C. 15
- D. 75

*Use the following information to answer the next question.*

A student was asked to solve the following radical equation:

$$\sqrt{x - 3} = -3$$

The student attempted to solve the equation and incorrectly found that  $x = 12$ . However, after checking her answer, the student found her error and made the following statement:

“This equation has no real roots.”

**Written Response — 5 marks**

2. a. • Explain why the student’s statement is correct.

- Complete the radical equation below, so that it will have a solution of  $x = 12$ .

$$\sqrt{x - 3} = \underline{\hspace{2cm}}$$

Use the following additional information to answer the next part of the question.

To solve the radical equation  $4 + \sqrt{x + 2} = x$ , the student needed to convert it to a quadratic equation. The student's steps are shown below; however, step IV is incomplete.

**Step I**      $\sqrt{x + 2} = x - 4$

**Step II**      $x + 2 = (x - 4)^2$

**Step III**      $x + 2 = x^2 - 8x + 16$

**Step IV**      $0 = \underline{\hspace{2cm}}$

- b. • Complete step IV of the student's work.

**Step IV**      $0 = \underline{\hspace{2cm}}$

- Show how you determine the value(s) of  $x$  for the quadratic equation you wrote in step IV.

- Verify your value(s) of  $x$  in the equation  $4 + \sqrt{x + 2} = x$  and state its solution.



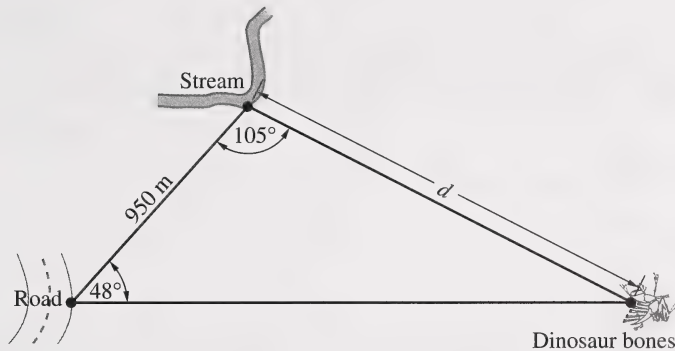
## ALBERTA INDUSTRY

Alberta dinosaur museums are world-renowned. The next questions are related to how mathematics is used by staff at a dinosaur museum.



Use the following information to answer the next question.

A dinosaur museum's field director planned to excavate some dinosaur bones. The excavation site and its relative distance from a road and from a stream are shown below.



23. The distance  $d$ , from the dinosaur bones to the stream, to the nearest metre, is
- A. 1 055 m
  - B. 1 555 m
  - C. 2 021 m
  - D. 2 093 m
- 

Use the following information to answer the next question.

To purchase a new truck needed for the excavation, the museum obtained a loan for \$53 000 at  $8\frac{1}{4}\%$  per annum over a period of 5 years.

### Numerical Response

6. The monthly payment on this loan, to the nearest dollar, is \$\_\_\_\_\_.

(Record your answer in the numerical-response section on the answer sheet.)

Use the following information to answer the next question.

Two trucks loaded with equipment travel from the museum to the excavation site located 500 kilometres away. Over this distance, the newer truck travels 10 km/h faster than the older truck.

24. If  $x$  represents the average speed of the **older** truck in kilometres per hour, then an expression for the time required for the **newer** truck to travel the 500 km is

A.  $\frac{x+10}{500}$

B.  $\frac{500}{x-10}$

C.  $\frac{500}{x+10}$

D.  $\frac{500}{x}$

Use the following information to answer the next question.

The museum purchased some land containing many well-preserved fossils and assumed a mortgage of \$80 000 over 5 years at an interest rate of 7% per annum.

25. If the monthly payment on the mortgage was \$1 580.33, then the total interest paid by the museum over 5 years could be determined by calculating

A.  $(\$1\,580.33 \times 60) - \$80\,000$

B.  $(\$1\,580.33 \times 5) - \$80\,000$

C.  $\$80\,000 - (\$1\,580.33 \times 5)$

D.  $\$1\,580.33 \times 60$

*Use the following information to answer the next question.*

The field director deposits \$200 each month into an annuity plan that earns interest at a rate of 6% per annum compounded monthly.

**Numerical Response**

- 7.** The amount of the field director's annuity after 2.5 years, rounded to the nearest dollar, would be \$\_\_\_\_\_.

(Record your answer in the numerical-response section on the answer sheet.)

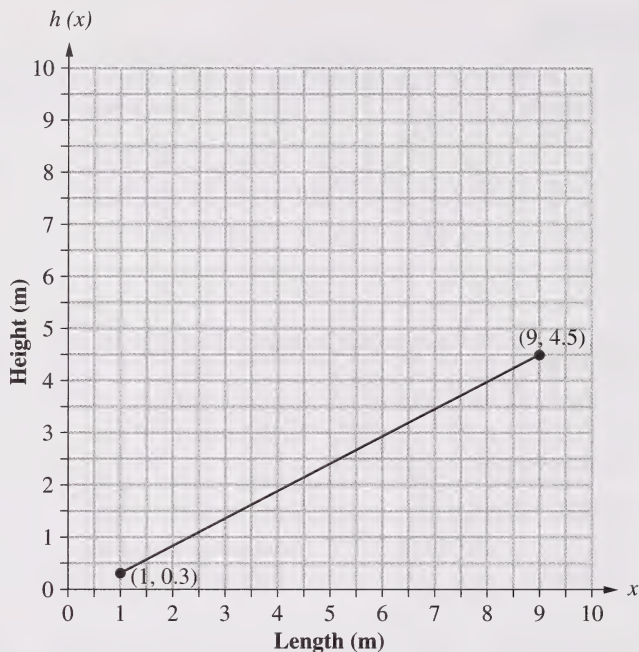
\_\_\_\_\_

- 26.** Another employee of the museum invested \$60 000 in order to obtain regular future payments during her retirement. The amount of money invested is known as the
- A.** amount of a loan
  - B.** amount of an annuity
  - C.** present value of a loan
  - D.** present value of an annuity



Use the following information to answer the next question.

Based on measurements from field specimens, a paleontologist derived a linear relationship between the average length and the average height of the *Maiasaura* dinosaur throughout its life, as shown below.

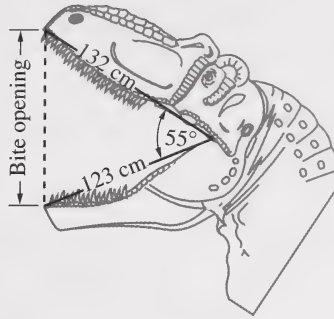


27. The domain of the function represented by the graph is

- A.  $0.3 \leq x \leq 4.5$
- B.  $0.3 \geq x \geq 4.5$
- C.  $1 \leq x \leq 9$
- D.  $1 \geq x \geq 9$

*Use the following information to answer the next question.*

Another paleontologist analyzed data related to the jaw of a Tyrannosaurus rex, as shown below.



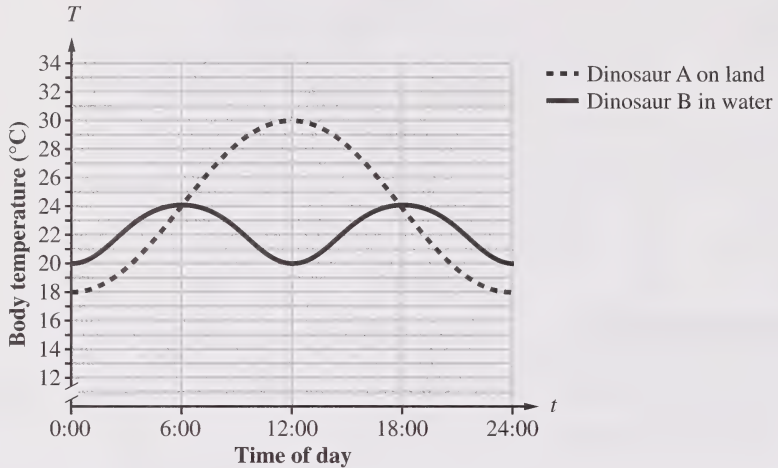
### **Numerical Response**

8. According to the data, the length of the Tyrannosaurus rex's bite opening, to the nearest centimetre, is \_\_\_\_\_ cm.

(Record your answer in the numerical-response section on the answer sheet.)

Use the following information to answer the next question.

The body temperatures of primitive dinosaurs fluctuated throughout the day. The possible body temperature of a dinosaur (*A*) that spent a day on land, and the possible body temperature of another dinosaur (*B*) of the same type that spent the same day in water, are graphed below.

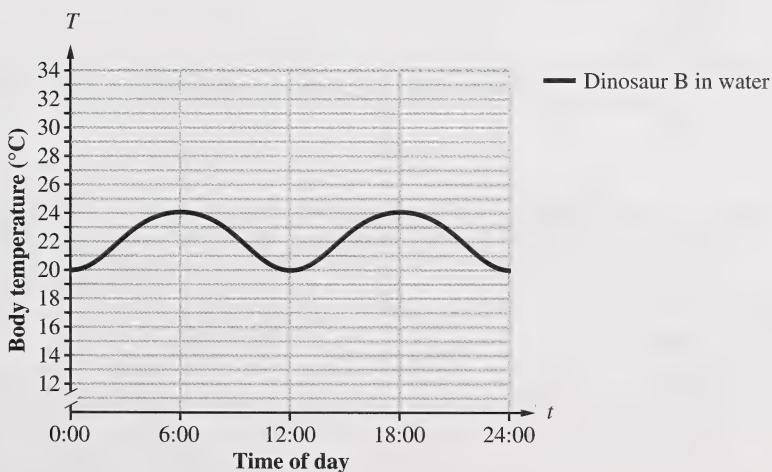


**Written Response — 6 marks**

3. a. According to the graph, at 12:00, the **difference** between the body temperature of dinosaur *A* and dinosaur *B* was \_\_\_\_\_°C.
- b. State the range for **each** function as represented graphically above and explain how the maximum and minimum values are related to these ranges.

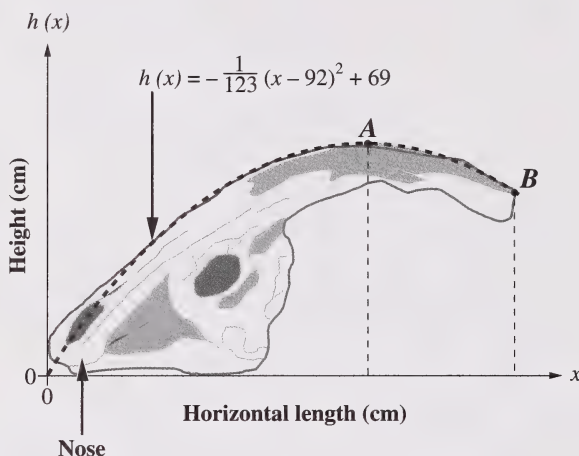
- c. Using numerical evidence from **each** graph, describe the changes in the body temperature of dinosaur *A* and the changes in the body temperature of dinosaur *B* between 6:00 and 18:00.

- d. The possible body temperature of another type of dinosaur (*C*) in water is always  $2^{\circ}\text{C}$  lower than the body temperature of dinosaur *B* in water. Draw the graph portraying the body temperature of dinosaur *C* over a 24-hour period on the grid below.



Use the following information to answer the next two questions.

To approximate the shape of the top ridge of a *Parasaurolophus* skull, a researcher at the museum developed the function  $h(x) = -\frac{1}{123}(x - 92)^2 + 69$ , where  $x$  is the horizontal length from the nose to any point along the top ridge of the skull, in centimetres, and  $h(x)$  is the height, in centimetres.



28. According to the function, the maximum height of the skull is
- A. 69 cm
  - B. 92 cm
  - C. 123 cm
  - D. 138 cm
29. If the horizontal length of the skull from the nose to point  $B$  is 132 cm, then according to the function, the height at point  $B$ , to the nearest centimetre, is
- A. 56 cm
  - B. 69 cm
  - C. 82 cm
  - D. 92 cm



*Use the following information to answer the next question.*

For a wall display, a curator needed a support structure in the shape of an oblique triangle with sides 21.8 cm, 32.4 cm, and 25.8 cm.

**Numerical Response**

9. The smallest angle in this triangle, to the nearest tenth of a degree, is \_\_\_\_\_°.

(Record your answer in the numerical-response section on the answer sheet.)

\_\_\_\_\_

*Use the following information to answer the next two questions.*

Over a one-month period, management at the museum conducted a survey on a random sample of patrons. To the question, “Is the cost of admission reasonable?”, 12 patrons said “yes.” Using a 90% box plot, management determined that the 90% confidence interval was between 10% and 20%.

**Numerical Response**

10. The sample size of patrons surveyed was \_\_\_\_\_.

(Record your answer in the numerical-response section on the answer sheet.)

30. If management had surveyed **all** the patrons coming to the museum over the one-month period, then those patrons would be referred to as the

- A. data
- B. sample
- C. inference
- D. population

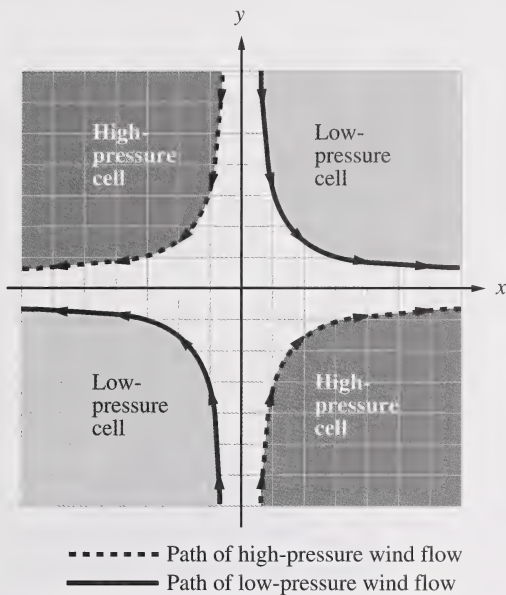
## WEATHER SCIENCE

Forecasters in weather stations use their mathematical knowledge to analyze and interpret data to make daily weather predictions. Use your mathematical knowledge to answer the following questions related to weather forecasting.



Use the following information to answer the next question.

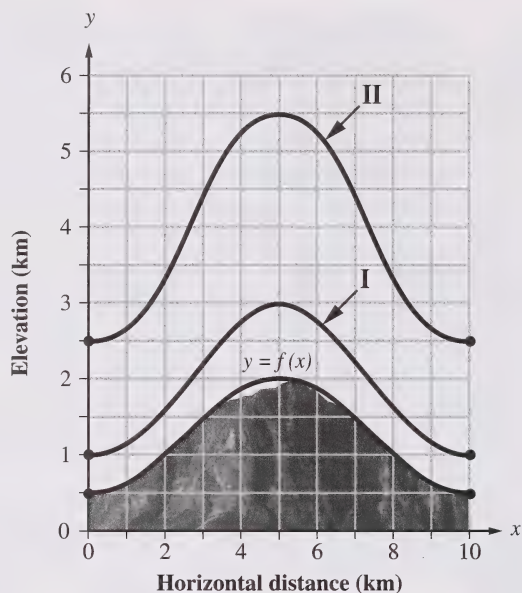
A weather forecaster observed a particular wind-flow pattern around low- and high-pressure cells, transmitted via satellite to her computer. This pattern is illustrated on the coordinate plane shown below.



31. The path of a low-pressure wind flow associated with the two low-pressure cells that are opposite each other is **most accurately** represented by the graph of
- A. an absolute value function
  - B. an exponential function
  - C. a reciprocal function
  - D. a quadratic function

Use the following information to answer the next question.

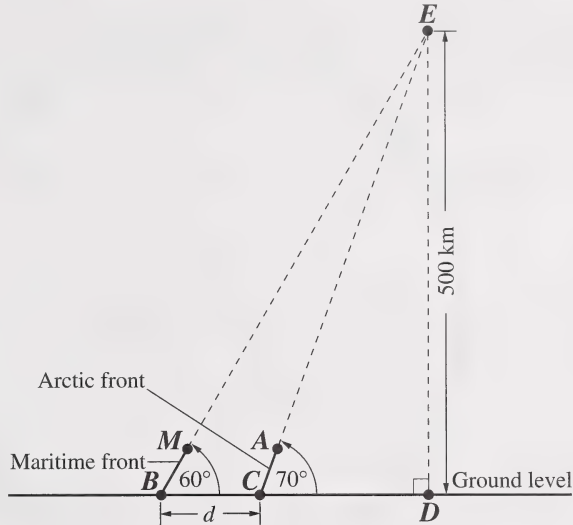
Air masses moving over the Rocky Mountains, follow a similar flow pattern regardless of their elevation. The air flow pattern directly above a particular mountain can be represented by  $y = f(x)$ , as shown below. The graphs representing two different air flow patterns can be produced by changing parameters in  $y = a \cdot f(x - h) + k$ .



32. The parameters that should be changed in  $y = a \cdot f(x - h) + k$  to produce graph II from graph I are
- A.  $a$  and  $h$
  - B.  $a$  and  $k$
  - C.  $h$  and  $k$
  - D.  $a$ ,  $h$ , and  $k$

Use the following information to answer the next question.

A forecaster sketches the positions of a Maritime front,  $\overline{BM}$ , and an Arctic front,  $\overline{CA}$ , in relation to a particular point ( $D$ ). He also constructs their corresponding triangles, as shown below.

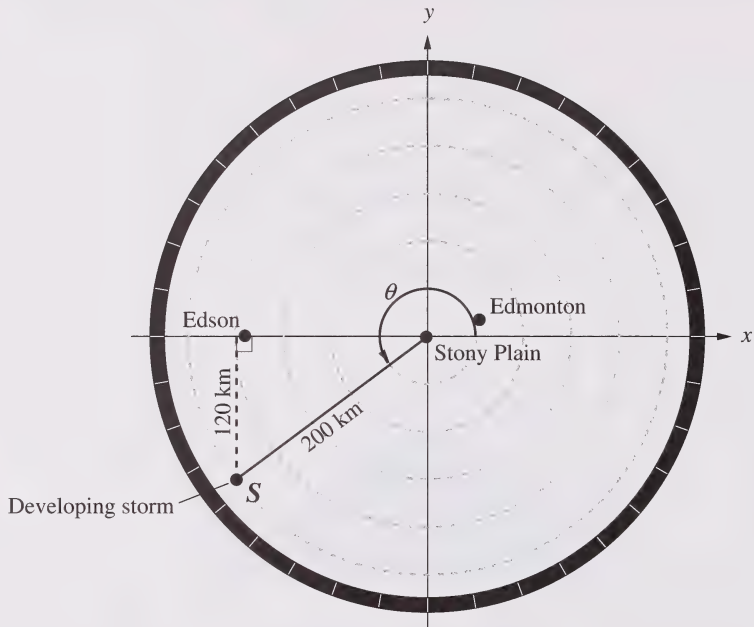


33. The distance,  $d$ , to the nearest kilometre, between the two fronts at ground level is
- A. 107 km
  - B. 289 km
  - C. 334 km
  - D. 471 km



Use the following information to answer the next question.

Another weather forecaster noted a storm developing at point  $S$  on a radar screen, as shown below. Point  $S$  is 200 km from Stony Plain and 120 km south of Edson.



34. The measure of angle  $\theta$ , to the nearest degree, is
- A.  $211^\circ$
  - B.  $217^\circ$
  - C.  $233^\circ$
  - D.  $239^\circ$

Use the following information to answer the next question.

To determine the velocity of clouds, a technologist analyzes the output of pulses from a Doppler radar antenna. She uses the function

$$v(x) = \frac{cx}{x - 2f},$$

where  $c, f \neq 0$ , and where  $v(x)$  is the velocity of the clouds in metres per second,  $c$  is the constant velocity of the pulse in metres per second,  $f$  is the constant frequency of the pulse in Hertz, and  $x$  is the Doppler shift in Hertz.

35. The velocity of the clouds,  $v(x)$ , is undefined when the Doppler shift,  $x$ , is equal to
- A.  $c$
  - B.  $f$
  - C.  $2c$
  - D.  $2f$
- 

Use the following information to answer the next question.

The “Beaufort scale” is used internationally to estimate wind speed. This scale is based on the equation  $v = 0.836\sqrt{B^3}$ , where  $v$  is the wind speed in metres per second, and  $B$  is the wind force given as a scale number.

### Numerical Response

11. If a strong wind registered a scale value of  $B = 9$ , then the wind speed,  $v$ , rounded to the nearest tenth of a metre per second, would be \_\_\_\_\_ m/s.

(Record your answer in the numerical-response section on the answer sheet.)

*Use the following information to answer the next question.*

The weather service in Red Deer conducted a random survey of people living in the surrounding area. Of 20 people who were asked, “Are you satisfied with the severe weather warning service in your area?”, 13 answered “yes.”

**Written Response — 5 marks**

- 4.** a. Using the result of the above survey and a 90% box plot chart, complete the following statement:

*“The 90% confidence interval for people satisfied with the severe weather warning service is between \_\_\_\_\_% and \_\_\_\_\_%.”*

- b. Another random sample of 40 people from the same area was also surveyed and asked the same question. Of those surveyed, 26 answered “yes.” Using a 90% box plot chart, write the 90% confidence interval statement based on this survey.

- c. In both surveys, the proportion of people responding “yes” is the same, but the confidence intervals for the population differ.
  - State why these confidence interval statements differ.
- d. Which survey provides more information about the population?
  - Which confidence interval statement is a more accurate prediction about the population? Explain why.

Use the following information to answer the next question.

The weather service in Red Deer also studied a randomly selected sample of 100 hailstorms. They found that 35 of these storms had grape-sized hailstones.

36. Based on the above sample, if 500 hailstorms were studied, then the 90% confidence interval for the number of these hailstorms that would have grape-sized hailstones would be between
- A. 125 and 175
  - B. 125 and 225
  - C. 150 and 200
  - D. 175 and 250

Use the following information to answer the next question.

The approximate distance from a lightning flash, in kilometres, can be determined by measuring the time, in seconds, between seeing the lightning flash and hearing the thunder, and then dividing by 3. The table of values below shows the linear relationship between the time,  $t$ , and the distance,  $d$ , of four lightning flashes from a weather station.

$t$ (sec)	3	6	9	12
$d$ (km)	1	2	3	4

### Numerical Response

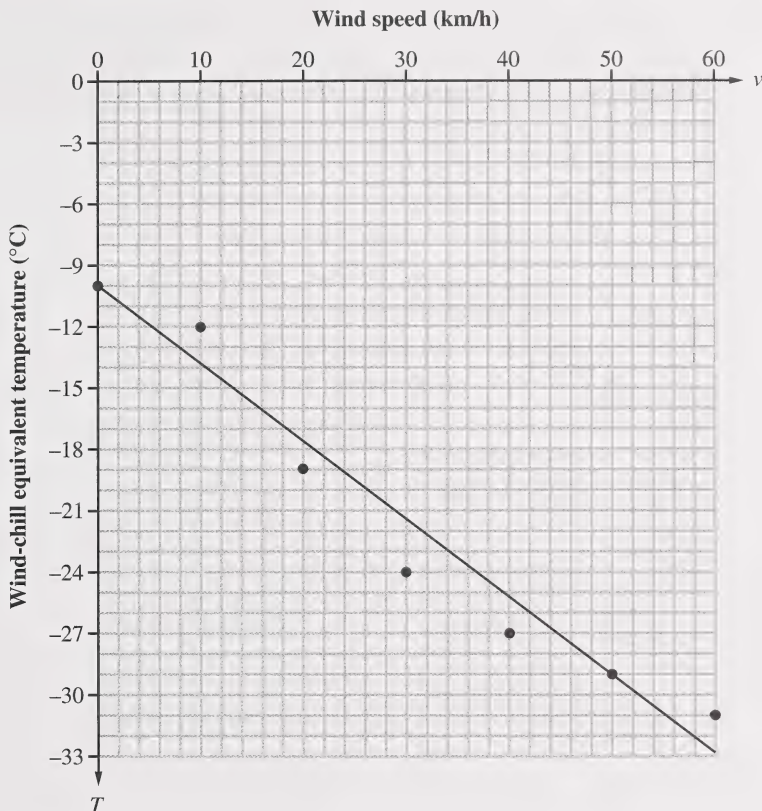
12. If the distance from a lightning flash to the weather station is 7 km, then the elapsed time between seeing the flash and hearing the thunder, to the nearest second, is \_\_\_\_\_ s.

(Record your answer in the numerical-response section on the answer sheet.)



Use the following information to answer the next question.

To analyze the relationship between the wind speed and the wind-chill equivalent temperature at the fixed air temperature of  $-10^{\circ}\text{C}$ , a forecaster analyzed the scatter plot shown below. A line of best fit has been included.



37. If two points on the line of best fit are  $(0, -10)$  and  $(50, -29)$ , then the equation of the line of best fit is
- A.  $T = -0.38v - 10$
  - B.  $T = -0.58v - 10$
  - C.  $T = -1.72v - 10$
  - D.  $T = -2.63v - 10$

*You have now completed the examination.  
If you have time, you may wish to check your answers.*

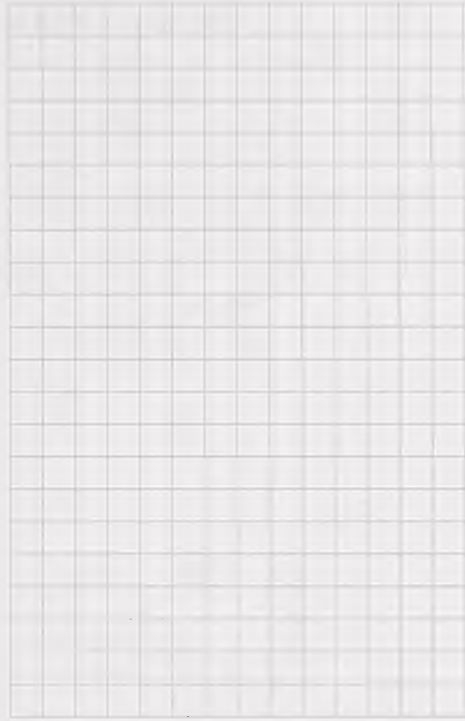
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